Useful Limitations:

Quantifying Functional Obsolescence

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Agenda

- Overview of Functional Obsolescence
- Effects on Ad Valorem Tax Appraisals for Industrial Properties
- Application of Useful Limitations
- Case Study Examples

Overview

- **Functional obsolescence** is the loss in value or usefulness of a property caused by inefficiencies or inadequacies of the property itself, when compared with a more efficient or less costly modern replacement

- Functional obsolescence from excess capital
  - Difference between reproduction cost and replacement cost

- Functional (operating) obsolescence from excess operating expenses
  - Caused by excess operating expenses of the subject when compared with its modern replacement

Overview

- Curable obsolescence - economically feasible to cure; the value added by the cure exceeds the cost of the cure.

- Incurable obsolescence - not economically feasible to cure; the value added by the cure does not exceed the cost of the cure.

Overview

- Causes of Operating Obsolescence
  - Excess operating labor
  - Excess maintenance and materials
  - Excess supplies and chemicals
  - Excess energy and utilities
  - Scrap and lower production yields

Overview

- Properties affected
  - Plants involved in the process industries
  - Plants with a high degree of technology
  - Older plants that expanded over time
  - Plants with redundant production lines
  - Plants with high operating expenses
  - Plants with inactive machinery

Effects on Ad Valorem Tax Appraisals

- **Cost Approach**
  - Adjustment for impairment due to inefficiency or inadequacy

- **Sales Comparison Approach**
  - Adjustment for functional obsolescence applied to comparables

- **Income Approach**
  - Increase operating expenses per unit of production
  - Future capital costs to correct design deficiencies

Effects on Ad Valorem Tax Appraisals

- **Taxing Authorities**

  - Hard to quantify

  - Mass appraisal methods may limit quantification of all forms of obsolescence

  - Dependence on depreciation tables only

  - Limited information

Useful Limitations - *Identify*

- ***Identify*** **the Functional Obsolescence**
  - Talk to the plant manager
  - Physically inspect the subject property
  - Look for inefficiencies or bottlenecks
  - Request benchmarking information, maintenance studies, or other types of reports that summarize the plants capabilities and inefficiencies
  - Investigate major changes in technology
  - *Remember the facility's USE – Utility, Situs, Extra*

Useful Limitations - *USE*

- ***U for Utility***

  - Physically inspect the subject property

  - Have there been advances in technology

  - Review subject property for operation problems

  - Quantify “cost to cure” deficiencies

Useful Limitations - *USE*

- ***S for Situs***

  - Location of the subject property

  - Transportation restrictions

  - Facility design layout compared to modern facility

  - Equipment difference compared to modern facility

Useful Limitations - *USE*

- ***E for Extra Questions***

  - Features to be modified or removed?

  - Benchmarking studies

  - Maintenance studies

  - Other

Useful Limitations - *Quantify*

- ***Quantify*** **the Functional Obsolescence**
  - Study each phase of the plant's operation
  - Identify labor, material, operating expenses, and equipment costs for each phase
  - Compare each phase to the modern replacement
  - Determine total annual excess expenses
  - Tax effect the annual excess expenses
  - Estimate the remaining life of the inefficiencies
  - Determine the appropriate discount rate
  - Calculate the present value of the penalty

Functional Obsolescence Example

Functional Obsolescence due to excess operating expenses

	Subject	Modern Replacement
Annual Operating Expenses	**$700,000**	**$500,000**
Difference	$200,000	
Less Income Taxes at 35%	$70,000	
Annual Excess Operating Expenses After Tax	**$130,000**	
Present Value		
Period in Years	9	
Discount Rate	6.0%	
Present Value Factor	**6.8016**	
Functional Obsolescence Due To Excess Operating Expenses	**884,210**	

Cost Approach Summary

Reproduction Cost New

Less: Functional obsolescence due to excess capital cost

Equals: Replacement Cost New

Less: Incurable physical deterioration

Less: Economic obsolescence

Less: Incurable functional obsolescence due to excess operating expenses

Less: Curable physical deterioration

Less: Curable functional obsolescence

Less: Necessary capital expenditures

Plus: Land

Equals: Cost approach indicator of value

Industry Case Studies

1. Oil Refinery
2. Semiconductor Plant
3. Power Plant
4. Chemical Plant

Case Study #1

- USGC Oil Refinery Example
  - Subject - 3 Crude Distillation Units
  - Built piecemeal over last 50 years
  - Crude unit #1 – 55,000 barrels per day
  - Crude unit #2 – 45,000 barrels per day
  - Crude unit #3 – 100,000 barrels per day
  - Modern Replacement – 200,000 barrels per day capacity in one unit

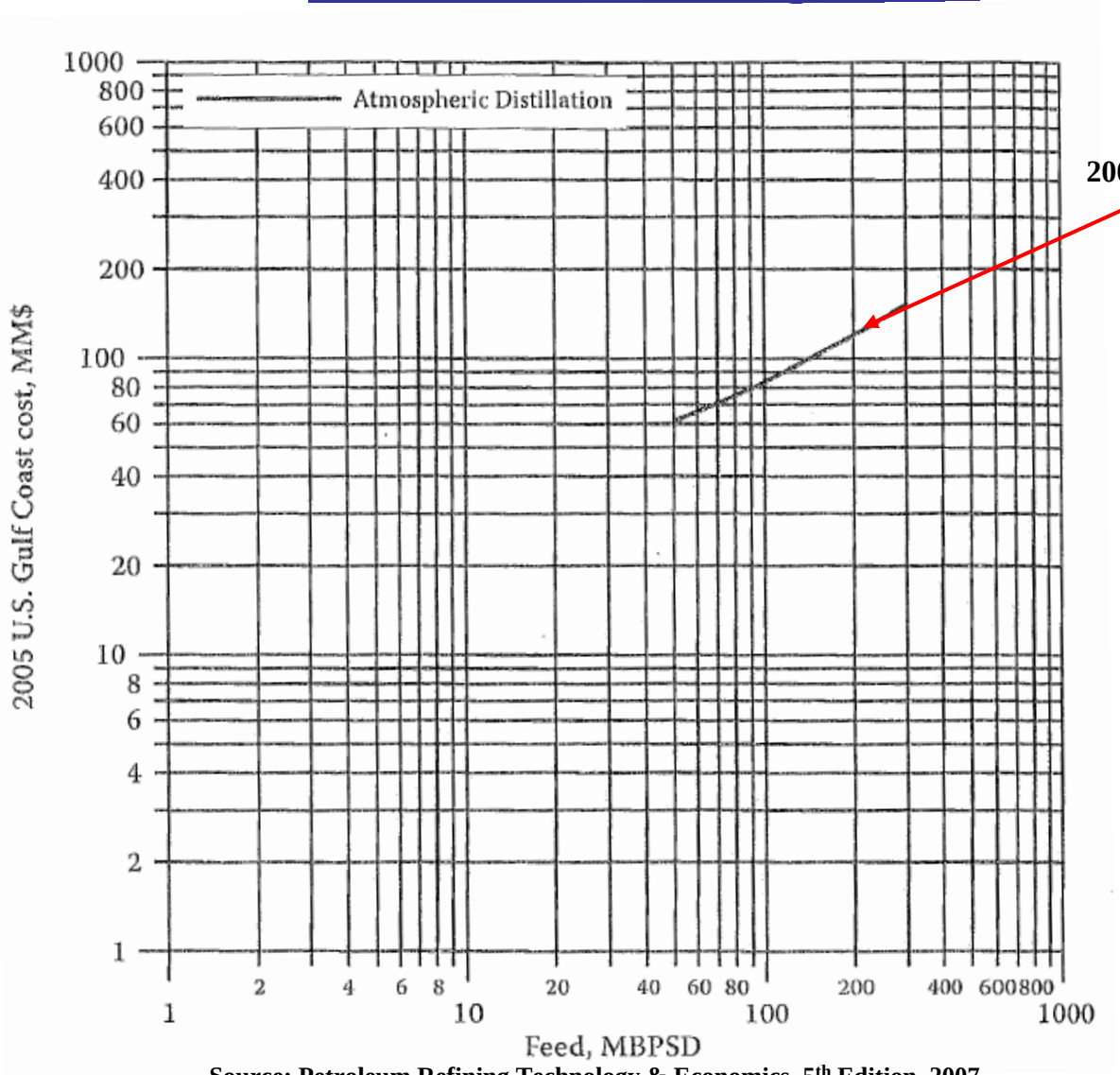
Case Study #1

- Reproduction Cost New
  - Trend historical cost to valuation date
  - Total RCN of $200,000,000

- Replacement Cost New
  - Modern Replacement – 200,000 barrels per day capacity in one crude distillation unit
  - M&S Petroleum Cost Index (2005 to 2011): 1.223
  - What is the cost of a modern replacement?

- Quantify Functional Obsolescence due to excess capital cost

Case Study #1



200,000 MBPSD = $130,000,000

Source: Petroleum Refining Technology & Economics, 5th Edition, 2007

Case Study #1

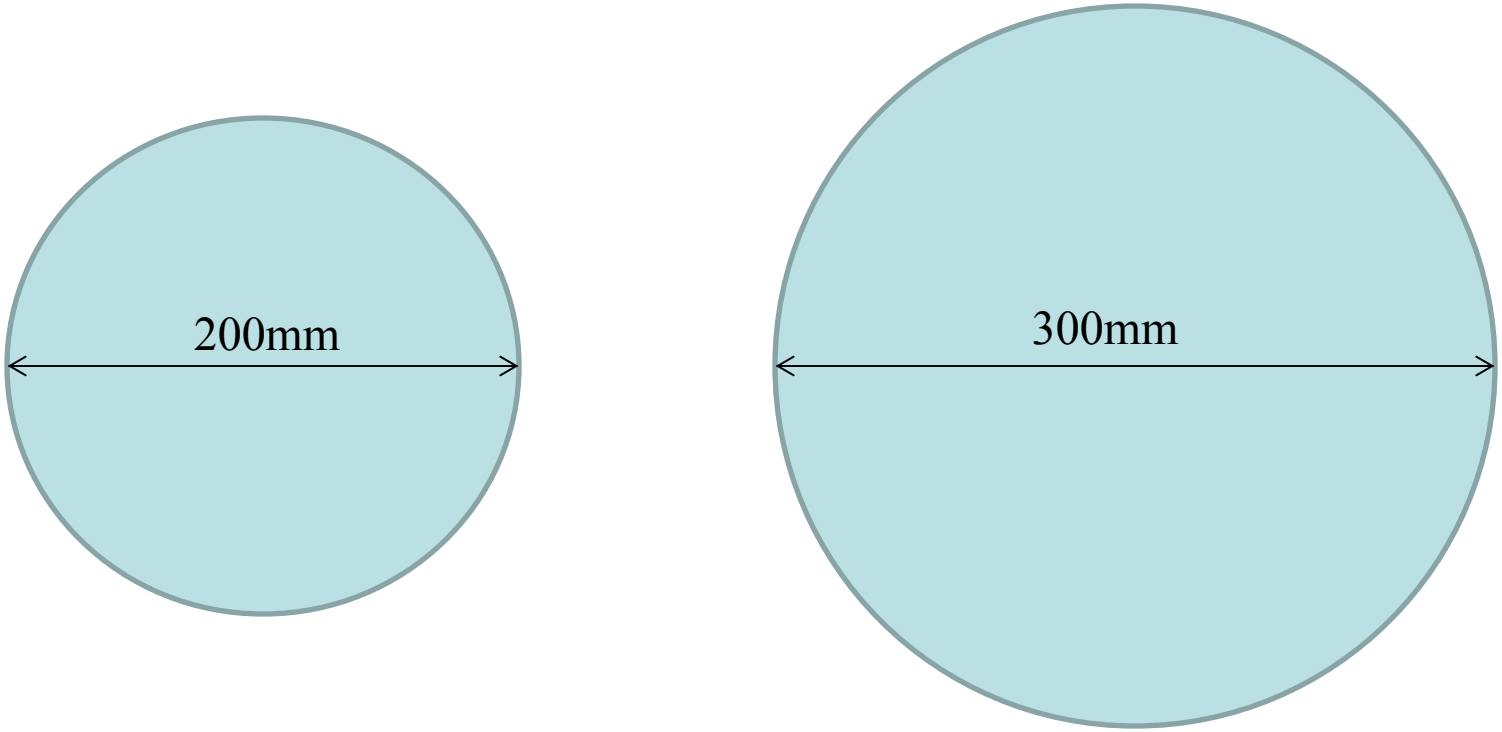
Reproduction Cost New	$200,000,000
Less Replacement Cost New	$159,000,000
Equals functional obsolescence due to excess capital cost	$41,000,000

Case Study #2

- Semiconductor Fab Example
  - Plant built in 2000 using 200mm wafer geometry and 0.25µm line width
  - 10,000,000 dyes per year capacity
  - Appraised by assessor using cost approach
    - Industry specific depreciation schedule
    - Captures rapid decline in economic viability of equipment
    - Floors value at 15% RCN after 5 years
  - Age based depreciation ignores changes in technology standards
    - Practical industry standard changed in 2002 to 300mm wafer geometry
    - Yield improvements derived from new geometry not accounted for in depreciation schedule
- Quantify Functional Obsolescence due to excess operating expenses

Case Study #2

Illustration of geometry difference



Case Study #2

- Calculation of wafer surface area

$$A = \pi r^2$$

200mm wafer = 31,400mm^2
300mm wafer = 70,650mm^2

- Usable wafer space increase exponentially with wafer diameter

Case Study #2

- Calculation of dyes per wafer (DPW)

$$DPW = d\pi\left(\frac{d}{4s} - \frac{1}{\sqrt{2s}}\right)$$

  - d = wafer diameter
  - s = integrated circuit area

Case Study #2

- If the subject and the modern replacement were producing the same integrated circuit product with a surface area of $4mm^2$ the yields would be:

  – $DPW_{200mm} = 7{,}627$

  – $DPW_{300mm} = 17{,}329$

Case Study #2

- The processing cost per wafer is known to be:
  - 200mm wafer = $1,800 per wafer
  - 300mm wafer = $2,430 per wafer
- Thus, the effective cost per IC unit is:
  - 200mm wafer = $\frac{\$1{,}800/wafer}{7{,}627\ dyes/wafer}$36 per dye
  - 300mm wafer = $\frac{\$2{,}430/wafer}{17{,}329\ dyes/wafer}$0 per dye

Case Study #2

Semiconductor Fab
Functional Obsolescence due to excess operating expenses

	Subject	Modern Replacement
Annual Operating Expenses	**$2,360,000**	**$1,400,000**
Difference	$960,000	
Less Income Taxes at 35%	$336,000	
Annual Excess Operating Expenses After Tax	**624,000**	
Present Value		
Period in Years	5	
Discount Rate	6.0%	
Present Value Factor	**4.212**	
Functional Obsolescence Due To Excess Operating Expenses	**$2,628,300**	

Case Study #3

- Power Generation Plant Example
  - Plant built in 1997
  - CCGT GE Frame 7FA
  - Heat Rate of 6,040 Btu/kWh
  - Modern Replacement GE Frame 7FB
  - Heat Rate of 5,940 Btu/kWh
  - Net Generation 500,000,000 kWh per year
  - Forecasted natural gas price of $5.00 per MMBtu

Case Study #3

- Quantify Functional Obsolescence due to excess operating expenses

  - Discount Rate - 6%
  - Remaining Useful Life – 10 years
  - Income Tax Rate - 35%

Case Study #3

Power Generation Plant
Functional Obsolescence due to excess operating expenses

	Subject	Modern Replacement
Annual Operating Expenses	**$15,100,000**	**$14,850,000**
Difference	$250,000	
Less Income Taxes at 35%	$87,500	
Annual Excess Operating Expenses After Tax	**$162,500**	
Present Value		
Period in Years	10	
Discount Rate	6.0%	
Present Value Factor	**7.360**	
Functional Obsolescence Due To Excess Operating Expenses	**$1,196,000**	

Case Study #4

- Chemical Plant Example
  - Plant built in 2006
  - Assessor cost approach fails to account for all forms of depreciation and obsolescence
  - Total depreciation is understated using a 10 year life for chemical manufacturing equipment
  - No consideration for functional & economic obsolescence
  - Cost to cure bottleneck in process = $5 million
- Quantify Curable Functional Obsolescence

Case Study #4

- Typical Assessor Cost Approach
  - Reproduction Cost New = Historical cost x trend factor
  - Physical depreciation derived from table or curve: % good factor (%GF)
  - Functional and economic obsolescence accounted for with a service factor (SF)
  - Cost indicator of value = RCN x %GF x SF

Case Study #4

Historical Cost Basis	$100,000,000
Physical Depreciation (42%)	$42,000,000
Economic Obsolescence	$0
Functional Obsolescence	$0
Market Value	$58,000,000

Case Study #4

Chemical Manufacturing Plant

Reproduction Cost New	$100,000,000 (Indexed Historical Cost)
Physical Depreciation	42% (58% GF)
Current Production	2,000,000 lbs/year
Cost to Cure Process Bottleneck	$5,000,000

Revised Assessors Cost Approach Summary

Reproduction Cost New x %GF x SF = Indicated Market Value

$100,000,000 x .58 x .9138 = $53,000,000

Conclusion

Reproduction Cost New

Less: Functional obsolescence due to excess capital cost

Equals: Replacement Cost New

Less: Incurable physical deterioration

Less: Economic obsolescence

Less: Incurable functional obsolescence due to excess operating expenses

Less: Curable physical deterioration

Less: Curable functional obsolescence

Less: Necessary capital expenditures

Plus: Land

Equals: Cost approach indicator of value

Thank You